MA 123 Fall 2024
Elementary Calculus

Exam 4
12/18/24

Name: _____

Student ID #: 9_____ **Sec:** _____

Do not remove this answer page — you will turn in the entire exam. You have two hours to do this exam. No books or notes may be used. You may use an ACT-approved calculator during the exam, but NO calculator with a Computer Algebra System (CAS), networking, or camera is permitted. Absolutely no cell phone use during the exam is allowed.

The exam consists of 2 short answer questions and 18 multiple choice questions. Answer the short answer questions on the back of this page, and record your answers to the multiple choice questions on this page. For each multiple choice question, you will need to fill in the circle corresponding to the correct answer. For example, if (a) is correct, you must shade

(a) (b) (c) (d) (e)

It is your responsibility to make it CLEAR which response has been chosen. **You will not get credit unless the correct answer has been clearly marked on this page.**

GOOD LUCK!

3. (a) (b) (c) (d) (e)

4. (a) (b) (c) (d) (e)

5. (a) (b) (c) (d) (e)

6. (a) (b) (c) (d) (e)

7. (a) (b) (c) (d) (e)

8. (a) (b) (c) (d) (e)

9. (a) (b) (c) (d) (e)

10. (a) (b) (c) (d) (e)

11. (a) (b) (c) (d) (e)

12. (a) (b) (c) (d) (e)

13. (a) (b) (c) (d) (e)

14. (a) (b) (c) (d) (e)

15. (a) (b) (c) (d) (e)

16. (a) (b) (c) (d) (e)

17. (a) (b) (c) (d) (e)

18. (a) (b) (c) (d) (e)

19. (a) (b) (c) (d) (e)

20. (a) (b) (c) (d) (e)

Short Answer Questions

Each question is an opportunity to earn 5 points. Points are earned on the clarity and correctness of your work, not merely on having a correct answer somewhere.

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1. Determine the maximum value of $f(x) = x^3 - 12x^2 + 36x$ on the interval $[-5, 4]$. **Show all work** and **circle your final answer**. You can use a calculator to check your answer, but credit is only given for methods that use calculus.

2. Use u-substitution to evaluate $\displaystyle\int_1^2 \frac{x^7 + 1}{\sqrt{x^8 + 8x}}\, dx$.

Name: _____

Multiple Choice Questions

Clearly mark your answer on the cover page on this exam for credit.

3. Evaluate $\lim_{t \to 2} \dfrac{t^2 - 4}{t^2 - 11t + 18}$.

   Possibilities:

   (a) $\dfrac{4}{11}$

   (b) $-\dfrac{4}{7}$

   (c) 0

   (d) 1

   (e) The limit does not exist.

4. Let $f(x) = x^3 + 5x - 14$. Determine a positive value of x such that the average rate of change of $f(x)$ from 0 to x equals 9.

   Possibilities:

   (a) 16

   (b) 9

   (c) 5

   (d) 4

   (e) 2

5. Let $f(x) = 5x^2 + 7x - 3$. The tangent line to the graph of $y = f(x)$ at $x = 8$ passes through the point $(4, y_1)$. Determine the value of y_1.

Possibilities:

(a) 373

(b) 105

(c) -323

(d) 25

(e) 721

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6. If $h(t) = -16t^2 + 6t + 13$ represents the height of an object in feet above ground level at time t seconds, determine the height of the object at the time when its speed is zero (prior to hitting the ground).

Possibilities:

(a) 13.5625 feet

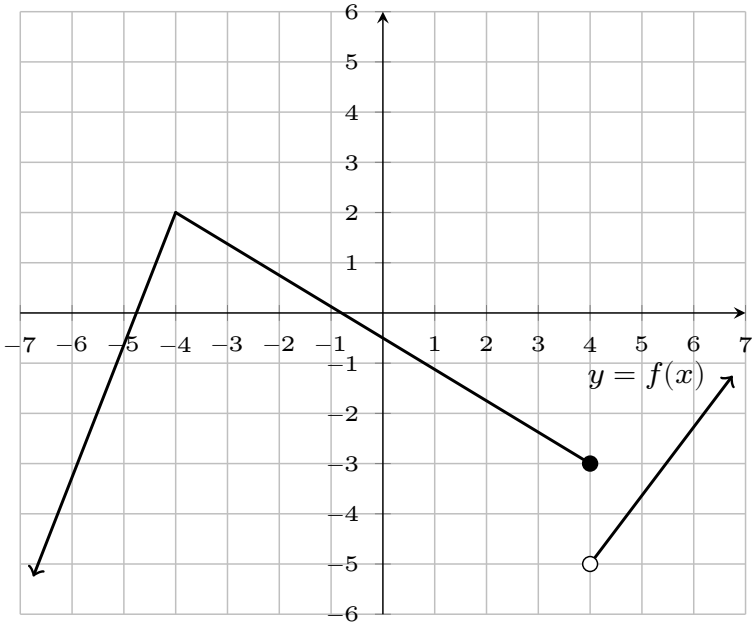
(b) 19 feet

(c) 0.1875 feet

(d) 13 feet

(e) 6 feet

7. The graph of $y = f(x)$ is shown below. Evaluate $\lim_{x \to 4^+} f(x)$.



Possibilities:

(a) -5

(b) -4

(c) The limit does not exist.

(d) -3

(e) -2

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8. Suppose $f(6) = -5$, $f'(6) = 4$, $g(36) = 3$ and $g'(36) = -9$. If $h(x) = f(x) \cdot g(x^2)$, determine $h'(6)$.

Possibilities:

(a) 552

(b) -528

(c) -432

(d) -36

(e) 57

9. The total revenue (in dollars) from selling x machines is

$$R(x) = 1676x - 7x^2.$$

Use the marginal revenue function to approximate the additional revenue from selling the 60th machine.

Possibilities:

(a) Approximately \$1263.

(b) Approximately \$1256.

(c) Approximately \$850.

(d) Approximately \$836.

(e) Approximately \$1050.

10. Let $f(x) = \sqrt{x^9} + \dfrac{7}{x^4}$. Determine the derivative $f'(x)$.

Possibilities:

(a) $18x^{17} - 28x^{-5}$

(b) $\dfrac{9}{2}x^{7/2} - 28x^{-5}$

(c) $\dfrac{9}{2}x^4 - \dfrac{7}{4}x^{-3}$

(d) $\dfrac{9}{2}x^4 - 28x^3$

(e) $\dfrac{9}{2}x^{7/2} - 28x^3$

11. The concentration of Acetaminophen in the bloodstream t hours after the drug is administered is given by

$$C(t) = \frac{0.26t}{t^2 + 7}.$$

Determine the instantaneous rate of change of the Acetaminophen concentration at $t = 3$ hours.

Choose the numeric value that most closely approximates the answer.

Possibilities:

(a) -0.0325 units per hour

(b) 0.0345 units per hour

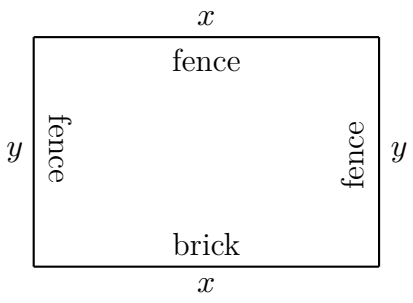
(c) -0.0020 units per hour

(d) 0.0433 units per hour

(e) 0.5525 units per hour

12. A landscape architect plans to enclose a 675 square foot rectangular garden on one side with a brick wall costing \$90 per foot and on the other three sides with a metal fence costing \$60 per foot. Determine the minimum cost to enclose the garden.

Choose the numeric value that most closely approximates the answer.



Possibilities:

(a) \$7249.85

(b) \$7085.92

(c) \$6796.12

(d) \$6971.37

(e) \$6667.53

13. Consider the point labeled A on the graph of the function $y = f(x)$. Use the graph to determine the signs of f' and f'' at A.

Possibilities:

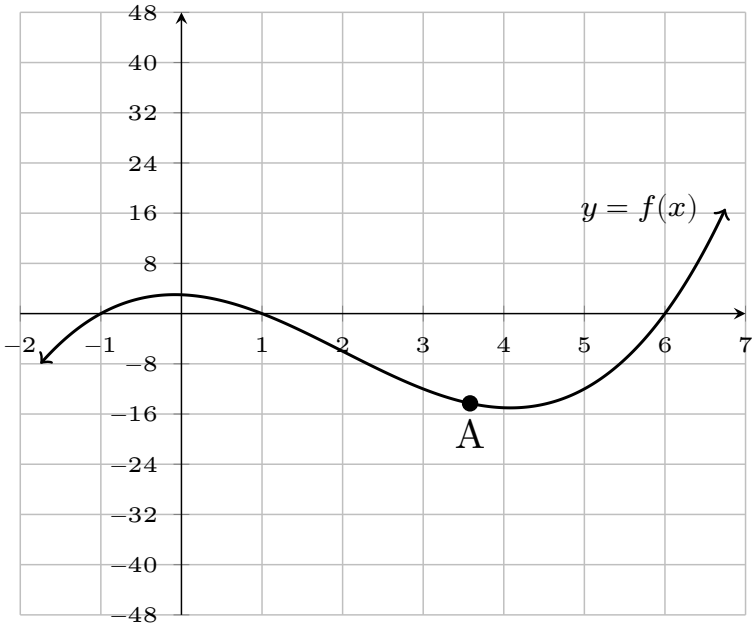
(a) $f' < 0$ and $f'' < 0$

(b) $f' > 0$ and $f'' > 0$

(c) $f' < 0$ and $f'' > 0$

(d) $f' > 0$ and $f'' < 0$

(e) $f' = 0$ and $f'' = 0$



14. Suppose the derivative of $g(t)$ is $g'(t) = 3t^4 + 36t^3 + 15$. Determine all values of t where $g(t)$ has an inflection point. You may assume that $g(t)$ is defined for all t.

Possibilities:

(a) -9 and 0

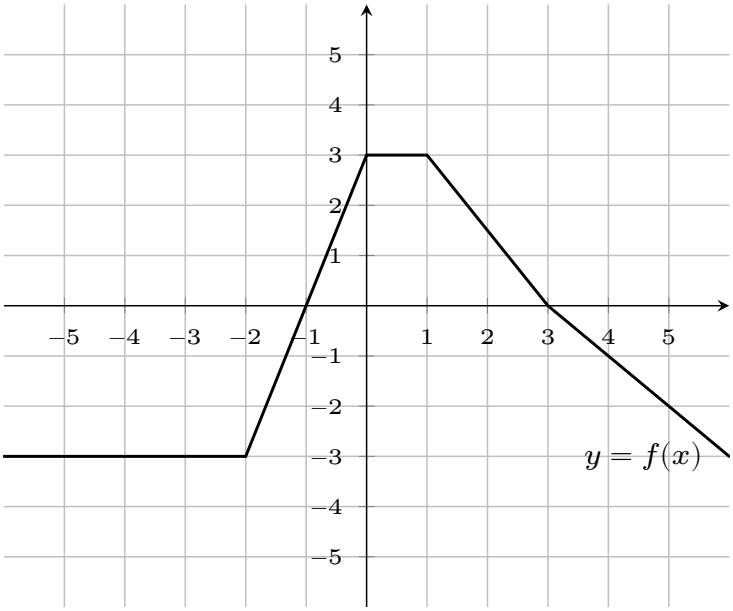
(b) -6

(c) -6 and 0

(d) 0

(e) -9

15. The graph of $y = f(x)$ shown below consists of straight lines. Evaluate the definite integral $\int_{-5}^{4} f(x)\,dx$.



Possibilities:

(a) $-\dfrac{37}{2}$

(b) $-\dfrac{5}{2}$

(c) $\dfrac{37}{2}$

(d) $\dfrac{35}{2}$

(e) $-\dfrac{7}{2}$

16. Given the function $f(x) = \begin{cases} 6 & \text{if } x < 4, \\ x + 2 & \text{if } x \geq 4, \end{cases}$ evaluate the definite integral $\int_{0}^{8} f(x)\,dx$.

Possibilities:

(a) 152

(b) 56

(c) 104

(d) 88

(e) 44

17. Suppose a rock is thrown from a Saturnian cliff. After t seconds, its speed in feet per second is $s(t) = 38t + 4$, at least until it hits the ground. If the rock hits the ground after 6 seconds, how high is the cliff?

Possibilities:

(a) 232 feet

(b) 1392 feet

(c) 708 feet

(d) 688 feet

(e) 1372 feet

18. Determine the indefinite integral $\displaystyle\int \frac{x^8 - 4x^5}{x^6}\,dx$.

Possibilities:

(a) $\dfrac{1}{2}x^3 + C$

(b) $\dfrac{1}{3}x^3 - 4\ln|x| + C$

(c) $2x + 4x^{-2} + C$

(d) $x - 4\ln|x| + C$

(e) $x + 8x^{-2} + C$

19. Determine the indefinite integral $\int (x^2+1)\, e^{9x^3+27x+6}\, dx$.

Possibilities:

(a) $\left(\frac{1}{3}x^3 + x\right) e^{9x^3+27x+6} + C$

(b) $2xe^{9x^3+27x+6} + 27\left(x^2+1\right)^2 e^{9x^3+27x+6} + C$

(c) $27e^x + C$

(d) $\frac{1}{27}e^{9x^3+27x+6} + C$

(e) $27\frac{e^{9x^3+27x+7}}{9x^3+27x+7} + C$

20. Evaluate $\int_2^5 (36t^3+6)\, dt$.

Possibilities:

(a) 5487

(b) 21924

(c) 4218

(d) 4212

(e) 5499

Formulas

Areas:

Circle: $A = \pi r^2$

Triangle: $A = \dfrac{bh}{2}$

Rectangle: $A = lw$

Trapezoid: $A = \dfrac{b_1 + b_2}{2}\, h$

Volumes:

Rectangular Solid: $V = lwh$